Treatment of Pain and Neuromuscular Tension

A Report on Intravenous Use of Tetracaine in 365 Cases

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• *Three hundred and sixty-five patients were given tetracaine intravenously for various types of pain and neuromuscular tension. In the treatment of pain, myositis, muscle spasm, and visceral spasm most patients were relieved. Best results were obtained in syndromes in which pain was associated with muscle spasm, such as in pain in the lower part of the back and scalenus anticus syndromes. The effects of tetracaine intravenously are those of analgesia, vasodilatation, and relaxation of spastic muscle. Sixty-five of the patients were treated for neuromuscular tension, and there was good relaxation and increased comfort. Alcoholics were relieved of some of the tension symptoms and may have been helped to resist the desire to drink. Of 14 patients with premenstrual tension, 13 had complete relief. Eight patients with mixed anxiety and tension states also responded well.*

Toxic and allergic reactions were negligible, and other side effects were infrequent and of no consequence.

THIS IS A REPORT of a three-year study of the intravenous use of tetracaine in the treatment of pain and neuromuscular tension. Over fifteen hundred injections were given by the author and others. The study was carried out in a leprosarium, an industrial clinic, a neuropsychiatric residency, and in private practice. Tetracaine,* a local anesthetic drug of the procaine series, has been widely used as a spinal and topical anesthetic. Compared with procaine, it has a longer duration of action and a more profound anesthetic effect. As procaine was known to be an effective drug for intravenous use in the treatment of various kinds of pain, it seemed logical to use tetracaine, as its higher potency would make possible the use of smaller amounts that could be administered by a syringe instead of with a flask and tubing as was required with procaine.

Local anesthetic agents have been used for many years in the treatment of pain. They have been used for blocking nerves, to interrupt the conduction of pain impulses, for the injection of so-called "trigger points," or points of maximum tenderness in a painful area, for infiltration of painful muscles and skin, and intravenously in the case of procaine. Results have been excellent in relieving pain, in increasing circulation in some types of ischemia, and in relaxing spastic muscle. Often an injection of a small quantity of a local anesthetic drug will break up a vicious cycle of pain of long standing and give complete and permanent relief.

When tetracaine is injected locally, it causes analgesia and relaxation of spastic muscles, and it acts as a powerful vasodilator. It can be given in concentrations less than one-tenth the usual concentration of procaine, with much longer duration of action, and with very slight toxicity and side effects.

Numerous animal experiments established the safety of tetracaine when injected intravenously. Lundy,[6] experimenting with dogs, noted that large amounts of tetracaine could be given intravenously before fatal effects were observed. In one dog, 150 mg. of tetracaine intravenously in five minutes did not alter blood pressure. In another, a total of 850 mg. was required to cause death. Hirschfelder[4] noted that tetracaine given intravenously to dogs decrease experimentally induced auricular fibrillation. Pfitzner[9] reported that tetracaine administered intravenously to animals was six times as toxic as procaine, but ten to twenty times as potent.

Moore[7] and Bonica[2] reported large series of nerve blocks done with tetracaine in humans, with excellent results. In the author's experience, the effect was good in over 400 nerve blocks and infiltrations. There is, however, in many physicians a great fear of tetracaine and a great reluctance to inject it. This fear seems to be based on the occurrence of accidents in cases in which tetracaine was used as a topical anesthetic in the mouth and throat. Owing partly to its powerful vasodilator effects, the drug seems to "explode" into the blood stream when applied to a mucous membrane without the addition of a vasoconstrictor. A number of deaths have occurred because of this attribute.

However, in a careful search of the literature, report of only one death following injection of tetracaine for nerve block was found, and in that instance the patient was a poor risk and hyaluronidase was

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*Tetracaine used was Pontocaine,® supplied through the courtesy of Winthrop-Stearns Co.

mixed with the anesthetic agent.[8] It would appear that injecting this drug into tissues is much safer than spraying it on a mucous membrane. In view of the qualities mentioned, it seemed logical to try tetracaine intravenously in small quantities given slowly.

RESULTS

Two hundred ninety patients were treated for pain, and when many of them reported better sleep and relaxation following intravenous administration of tetracaine, the treatment was tried in 65 cases for relief of neuromuscular tension, not only in persons who were tense and unable to relax, but also in patients with neurological diseases such as multiple sclerosis for the treatment of uncomfortable muscle spasms, and for conditions such as the so-called scalenus anticus syndrome in which pain and muscle spasm are found together, operating in a vicious cycle. In ten cases, the drug was tried on patients with multiple sclerosis and amyotrophic lateral sclerosis. It had no effect on the neurological condition.

The dose given for relief of pain was 10 cc. of 0.25 per cent solution of tetracaine. Fifty of the patients were treated for pain in the lower part of the back, and in about 90 per cent of the cases there was almost complete relief after one injection of tetracaine intravenously. About half of the remainder were helped very little or not at all, and the rest had some improvement. Nine of ten patients with tension headaches and occipital neuralgia and six of eight patients with various kinds of pain in the chest had good results. Four patients had scalenus anticus syndrome or a variant of it, and all were relieved. The following case reports are illustrative:

CASE 1: A 52-year-old white woman complained of pain in the right biceps and right hand which had become progressive over a period of three months. A neurosurgeon who examined the patient for rupture of a cervical intervertebral disk or tumor around the cervical spine said neither of these conditions was present. On palpation, the right anterior scalene muscle was extremely tender and felt spastic. Scalenus anterior syndrome was considered to be the cause of pain. The patient was given 10 cc. of 0.25 per cent tetracaine solution intravenously and pain was almost immediately relieved. Three days later some pain recurred. The injection was repeated with complete relief. There was no further recurrence.

CASE 2: A white man 57 years of age had posterior myocardial infarction in May of 1950, with subsequent anginal pain so severe as to necessitate opiates for relief. In June of 1950 pain in both shoulders and both hands developed. Stellate ganglion blocks gave only temporary relief. Physical therapy for three months gave very little relief. In September definite symptoms of ischemia of the left arm and hand were noted, and the fingers of the left hand were held in painful flexion contracture. Bilateral anterior scalene tenderness was present. Ten cubic centimeters of 0.25 per cent tetracaine solution was given intravenously. The contracted fingers relaxed immediately and the hand and arm became definitely pinker. The patient said that the pain was much less. Five days later pain increased somewhat and a second injection was given. Pain abated completely and the patient was discharged from the hospital at his own request.

In general, the best results with intravenous administration of tetracaine were obtained when it was used for pain that had no specific mechanical cause, other than muscle spasm. Smooth muscle and skeletal muscle were relaxed by the treatment. Four of the patients in the series had bladder pain and spasm following cystoscopy or acute cystitis. All had complete relief after one intravenous injection. Three patients with pain and anal spasm following hemorrhoidectomy had considerable relief. One woman, aged 34, had endometriosis with considerable pelvic pain. Oophorectomy was advised, but the patient declined. Experimentally, 10 cc. of 0.25 per cent tetracaine solution was given intravenously, and the pain disappeared. It recurred in seven days. The treatment was repeated and injections were continued weekly for fifteen weeks. After the fifteenth intravenous injection the patient noted slight wheezing and a slight reddening of the skin at the site of venipuncture. The following week a skin test was carried out by the intradermal injection of 0.1 cubic centimeter of 0.25 per cent tetracaine solution. A wheal about 6 by 9 centimeters developed in fifteen minutes. It was assumed that the patient had acquired allergic sensitivity to tetracaine, and use of the drug was discontinued. The symptoms manifested in this instance were mild and transient and did no harm. The patient was the only one in the present series in whom sensitivity to tetracaine developed, and questioning elicited that the patient had pronounced sensitivity to a large number of drugs, foods, and vegetable substances.

In patients with a definite mechanical cause for pain, other than muscle spasm, intravenous use of tetracaine had no effect. Tetracaine was given intravenously to patients with rib fracture, osteomyelitis with sequestrum formation, terminal carcinoma, dislocations, brachial-plexus avulsion, and bursitis. It did not relieve pain. Nor did it relieve the pain of syringomyelia in one patient. Amputees with phantom-limb pain were not benefited. Where pain was limited to the distribution of a single sensory nerve, blocking that nerve gave much better results than the intravenous injection. Polyarthritis responded better to procaine given intravenously than to tetracaine. In dysmenorrhea the drug helped in about 50 per cent of cases. In migraine headache there was occasional improvement.

NEUROMUSCULAR TENSION

Of the 65 patients given tetracaine for relief of tension, 42 were alcoholics, 15 had premenstrual tension, and eight had various forms of anxiety and tension. The dose given was 20 cc. of 0.25 per cent tetracaine hydrochloride, twice the amount given for pain. It was effective in about 90 per cent of cases. Higher concentrations of tetracaine up to 0.5 per cent were tried in some instances, but there were no advantages, and as a side effect some patients noted a transient numbness of the lips and tongue. The alcoholic patients were generally tense, neurotic persons with a tendency to panic states. In some, tension seemed to build up until some trivial incident precipitated panic and compulsion to drink to escape from panic. With the use of tetracaine, the alcoholic patients were helped to relax, and, in some cases, the relaxation seemed to help the patient to resist the compulsion to start drinking. In the sobering period, after days or weeks of drinking without proper nourishment, the tetracaine was mixed with 50 per cent dextrose solution and Lyo B-C,* to relieve anxiety, tremor, and generalized discomfort which sometimes lead to recurrence of drinking. It is not possible to give any quantitative measure of the effect of intravenous tetracaine, since the craving for tension relief from alcohol is a subjective experience not measurable objectively, and any factors tending to modify the craving would also be subjective in effect. All the patients stated that they felt more relaxed and less panicky. In this small series, it is not possible to give an exact evaluation, but it was felt that the tetracaine, alone or in combination with glucose and vitamins was relaxing, and gave comfort in difficult periods.

Of the 14 patients with premenstrual tension, 13 had complete relief for the period in which the injection was given. One woman, who underwent a hypomanic paranoid phase before each menses, had relief for only four hours, after which symptoms recurred. In most, the relaxation was immediate, and euphoria took the place of tension.

The eight patients with anxiety and tension from various causes, had good relief, and in most subjects, one injection gave relaxation for as long as two months.

The larger dose did not interfere with coordination, judgment, or any function. Practically every patient was treated in the office, and after a rest of ten minutes was able to drive a car or return to work without mishap.

* Lyo B-C® was supplied through courtesy of Sharp & Dohme, Glenolden, Pa.
The injection was made up of 20 cc. of 0.25 per cent tetracaine solution and 30 cc. of 50 per cent dextrose solution to which one bottle of Lyo B-C was added. A 50 cc. syringe was used.

TOXICITY

Toxic effects and side reactions were negligible in over 1,500 intravenous injections of tetracaine hydrochloride.* As previously reported[5] one patient fainted and one had emesis immediately after injection. It was found that making the patient lie on the examining table for ten minutes following treatment prevented fainting. Occasionally, patients had ringing in the ears and/or dizziness for a few minutes after injection. This never persisted for more than ten minutes. At no time were sedatives, oxygen, or stimulants necessary. Headache developed several hours after treatment in about one per cent of patients.

Allergic reactions to tetracaine were not common. In addition to the one patient previously mentioned, in whom sensitivity developed after 15 injections, skin sensitivity reactions were noted in three others in the course of routine testing. In all three, nerve block was contemplated and, as a routine precaution, 0.1 cc. of tetracaine was injected intradermally. A skin wheal larger than 2 cc. in diameter was considered evidence of possible sensitivity, and a different anesthetic agent than tetracaine was used. In each case the only sensitivity reaction was the skin wheal, and it was only temporary. No development of tolerance, dependence, or habituation occurred. As much as 250 milligrams of the drug have been given in 1,000 cc. of isotonic saline solution, without the signs of toxicity.

TECHNIQUE

In all cases tetracaine hydrochloride in sterile isotonic solution was used. The concentration of maximum effect and least toxicity has been found to be 0.25 per cent, or 1:400, which is equivalent to 2.5 mg. per cc. This can be made up by adding the contents of a 250-mg. ampule of Pontocaine "Niphanoid" (marked *Not For Spinal*) to 100 cc. of sterile isotonic saline solution. A rubber-stoppered bottle is the best container, and enough of the solution for many doses may be kept for one or two weeks. *The tetracaine should not be dissolved in distilled water* because the solution thus made would be hypotonic and undesirable for intravenous injection, and probably not effective.

The patient must be lying on a bed or examining table during and immediately after administration. A needle of gauge No. 23 or smaller is of help in

* Since the presentation of this paper, the author has been in communication with other physicians who have given tetracaine intravenously. The total number of injections given by them and the author exceeds 10,000, and no toxic effects of consequence have been noted.

giving the injection slowly. A suitable vein is selected, the skin is cleaned, and the vein punctured. About one-tenth of a cc. of the solution is injected, and the patient observed carefully. If no untoward reactions develop (the author has observed none), the rest of the dose is given slowly over a time interval of from five to ten minutes, with careful observation of the patient. It is important that the patient remain prone for at least five or ten minutes, preferably ten, after the needle is removed, in order to avoid dizziness and fainting. After that period he can do anything he normally does, without any impairment of his sensory perceptions, judgment, or motor function. The frequency of the injections depends upon the need. In some patients, good effects of one treatment persist for as long as three or four months. In acute pain or anxiety states, a daily injection may be necessary for four or five days. The author was unable to establish rules, but always gave the drug when it was requested.

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Recommends Law to Test Chemicals Added to Foods

The third report of the House Select Committee Investigating the Use of Chemicals in Foods praises the food industry for much of the progress in the field of nutrition but recommends that the Food, Drug and Cosmetics Act be amended to give Food and Drug Administration more control over foods. The committee recommends that proof of the safety of chemical additives be submitted to the FDA before chemically-treated foods are offered for sale. It points to the increasing use of chemicals in food production, processing, storage, packaging and distribution and to testimony delivered before the committee that some of these chemicals have not been tested properly and might be dangerous.

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